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Space Interferometry Mission

SIM PROJECT
PRELIMINARY INSTRUMENT SYSTEM REQUIREMENTS REVIEW
(PISRR)

Project System

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  - Technology Readiness Verification (TRV) matrix for key project system requirements
- Conclusion

SIM PROJECT DOCUMENT TREE

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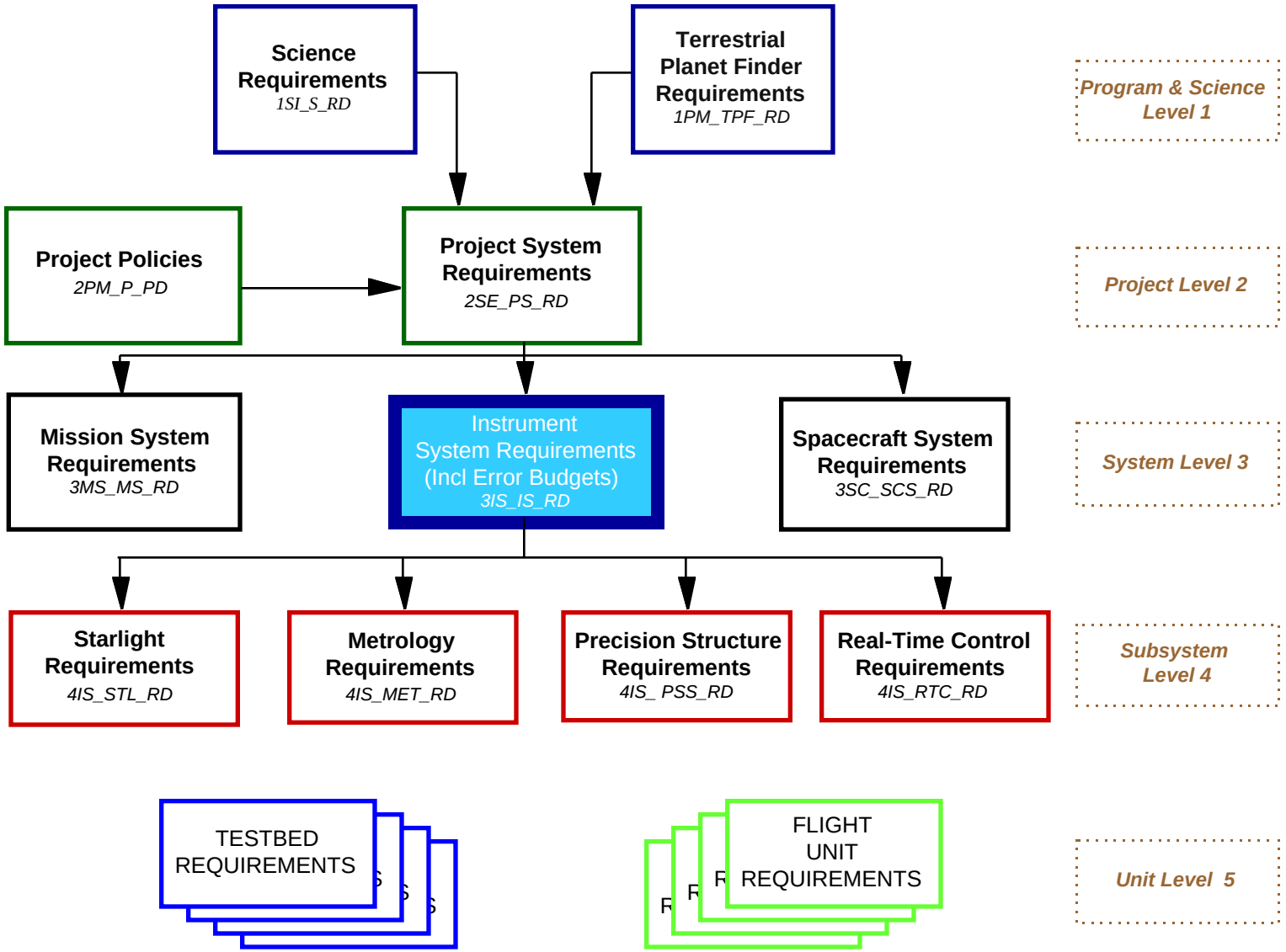
Mission

FUNCTIONAL OVERVIEW
REQUIREMENTS FLOWDOWN TREE



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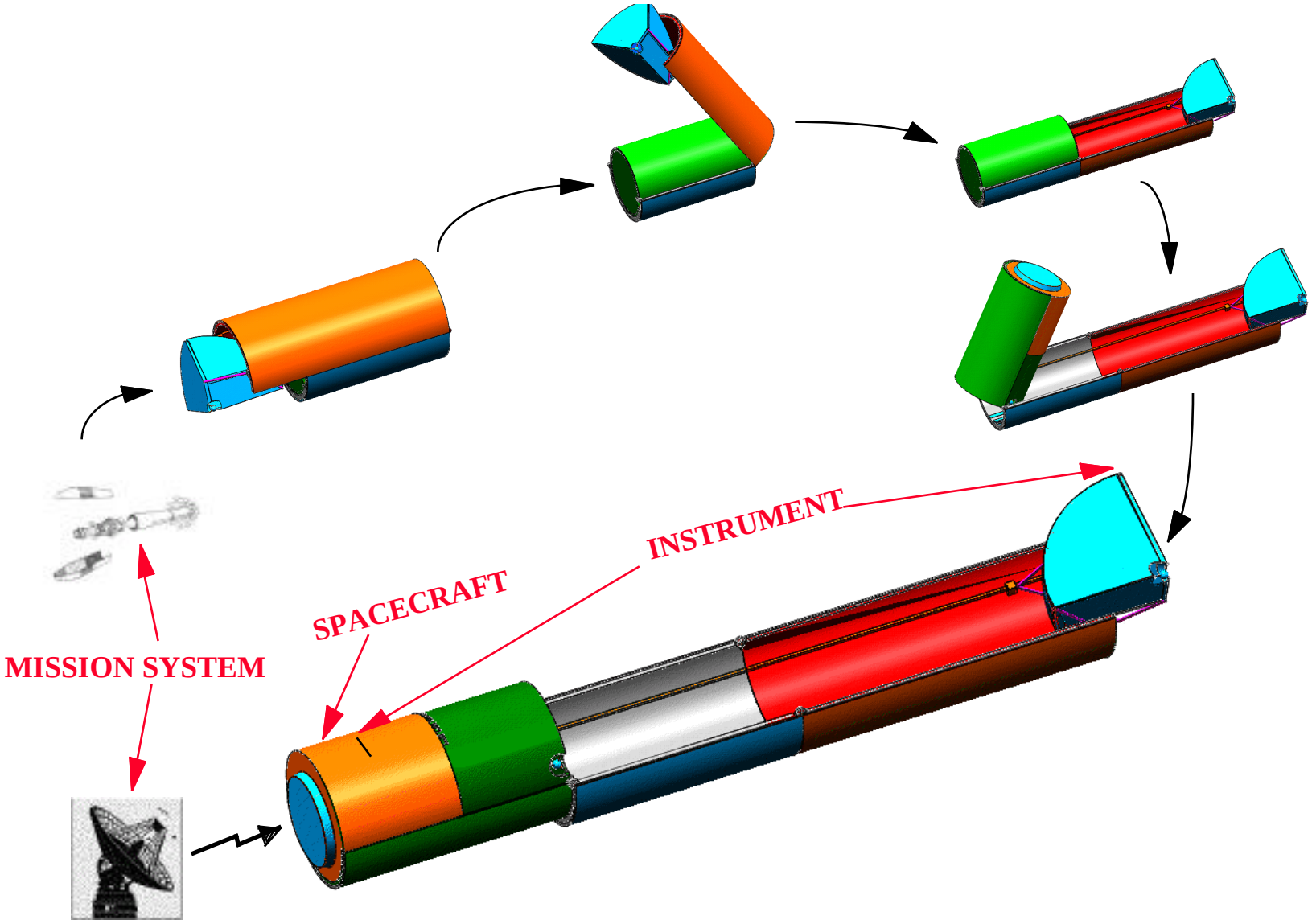
SIM PROJECT SYSTEMS



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PROJECT SYSTEM OVERVIEW

- Accepts requirements from level 1
  - SIM Science (SI)
  - Terrestrial Planet Finder (TPF)
  - Project Policies (PP)
- Synthesizes & derives SIM project requirements at level 2
- Allocates requirements to systems at level 3
  - Instrument
  - Spacecraft
  - Mission (design, operations, launch vehicle)

REQUIREMENTS DOCUMENTATION LEVELS

- Level 1 — Starlight measurement accuracy shall be . . .
- Level 2 — The SIM project shall . . .
- Level 3 — The instrument shall . . .
  The spacecraft shall . . .
  The mission shall . . .
- Level 4 — The starlight subsystem shall . . .
- Level 5 — . . . unit shall . . .

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APPROACH TO FLIGHT REQMTS ALLOCATIONS

- Maximize separation of instrument & spacecraft (engineering) functions
  - Keep interfaces as simple as possible
  - Goal is to use available engineering subsystems (possibly complete spacecraft)
  - Utilize proven new technology where cost, mass & performance improvements can be achieved at acceptable risk.

- Negotiate requirements flow down in reqmts "Pit" meeting
  - Agree with affected engineers
  - Document "on-line"
  - Trace using "DOORS" tracking tool

MASS SUMMARY (CBE)

	KG
Instrument Mass (including all structure)	1509
Spacecraft Mass (engineering subsystems only, no structure)	356 *
Launch Vehicle Adapter Mass	44
Total Flight System Mass	1909
Launch Vehicle capability (Delta III to e.t. orbit)	2700
Margin (@29%)	791

* Earth-trailing orbit baseline
Wet Mass

POWER SUMMARY (CBE)

	WATTS
Instrument Power	971
Spacecraft Power	366*
Total Flight System Power	1337
Solar Panel capability (depends on attitude relative to sun)	900 - 3800
Margin	Battery will augment solarpanels for certain orientations

*- Earth-trailing orbit baseline

NEED FOR TESTBEDS

- SIM is first of a kind
  - Concepts not fully demonstrated
    - > Space
    - > Observatory
    - > Lab
- Many components developed in Interferometry Technology Program (ITP)
  - Some system functions demonstrated
- SIM system design concepts must be demonstrated prior to phase C/D
  - Set of testbeds being developed (augmentation of ITP testbeds, focus on SIM needs)
  - System engineering plan includes mapping of SIM system & subsystem requirements to testbeds
    - > As needed to retire risk

TESTBEDS PURPOSE

- System Testbeds will verify flight system concept
  - To retire technological risk associated with flight requirements
  - Includes system performance in most cases
- Testbeds do not verify flight components or flight system performance
  - Standard flight V&V matrix will be used for flight system verification

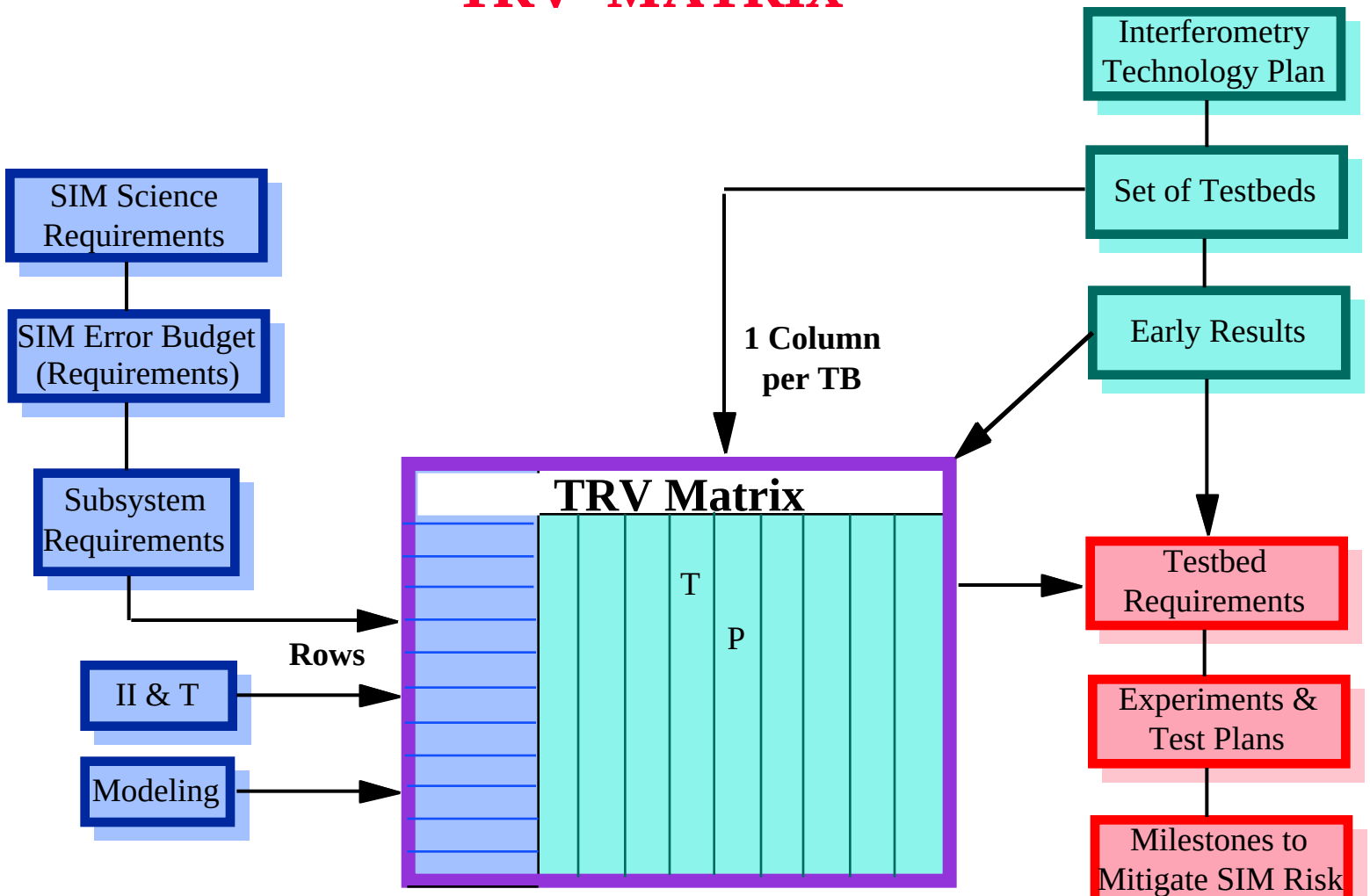
TESTBED FUNCTIONS

- TOM: Thermal Optical Mechanical Testbed
  - Validate thermal / optical modeling approach for SIM
  - Use carefully selected subset of SIM instrument components
- 1-D: One-Dimensional Metrology Testbed
  - Demonstrate picometer performance
  - Use complete set of metrology components
- STB-1: SIM Testbed Number One
  - Demonstrate optical pathlength stability below 10nm
  - single-baseline optical interferometer
  - vibration isolation, metrology, and active optical control
  - Apply realistic disturbance sources
- MAM - Microarcsecond Metrology Testbed
  - Demonstrate microarcsecond astrometric measurements
  - Same level of precision as SIM
  - Interferometer, metrology system, and artificial star
  - Enclosed in a vibration isolated, thermally stable vacuum tank

TESTBED FUNCTIONS (cont)

- RICST: Real-Time Interferometer Control System Testbed
  - Test incremental software deliveries
  - Closed loop test environment
  - Breadboard optomechanical and optoelectronic hardware
- ColPod: Collector Pod Testbed
  - Demonstrate star pointing acquisition
  - Partially demonstrate star (angle) feed forward tracking
  - Single prototype pod
- STB-3: SIM Testbed Number Three
  - Three-baseline interferometer
  - Equivalent complexity to SIM flight instrument
  - Demonstrate nanometer vibration attenuation in air
- IM: Integrated Modeling
  - Set of models that accurately predicts interferometer functions
  - Performance predictions
  - Error budget reallocation, design tradeoffs
  - Modeling capability validated on testbeds
- Met-,Stl-,MechComp:Metrology, Starlight, Mechanical Component Testbeds

TECHNOLOGY READINESS VERIFICATION
TRV MATRIX



T = TB must completely test to verify rqmt
P = TB must partially test to verify rqmt

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SUBSYSTEM AND TESTBED PRESENTATIONS

- Subsystems will show
  - Rqmts (rows) that must be demonstrated by the testbeds (one or more)
    - > TRV matrix reqmts (rows) identified in {braces}
    - > Rows based mostly on flight system error budget
- Testbeds will show
  - For testbed column,
    - > TRV matrix reqmts that must be veified by the testbad (printed directly from TRV matrix)
    - > First steps toward synthesizing the testbed reqmts & design
    - > Resulting top level requirements on testbed with indications where known on performance capability
- Detailed testbed requirements will be presented at individual testbed requirements reviews
- Testbeds also driven by project Technology plan
  - More detailed work in progress

STATUS OF TRV MATRIX

- Preliminary
  - Requirements & numerical values will change
    - > As error budget matures
    - > As elements of design mature
  - Mapping to testbeds will change
    - > As understanding of tech verification needs develops
    - > As testbed capability estimates mature
      - some “T”s / ”P”s may interchange or be added / deleted
  - Typos will be fixed, blanks filled in

- Refinement of TRV matrix will continue

CONCLUDING REMARKS

- SIM new configuration being defined by flowdown of requirements to subsystems and units
- Error budget being worked as part of the flowdown process
- TRV matrix tracks requirements mapping to testbeds
  - Focus of this review
- Testbed requirements will be developed from TRV matrix requirements and technology plan